

2/2/18 "A mistake is food for a new invention." -Anonymous

HW: "Vertical Stretching of Functions" homework section  
Test 1 on Thursday 2/15

AIM: How do we stretch functions vertically?

Warm Up:

What is the vertex of  $f(x) = -2.5(x-4)^2 - 18$ ?

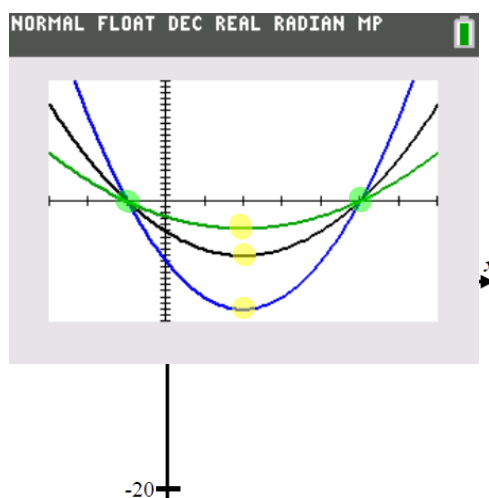
$$\begin{array}{r} (0,0) \\ +4 \quad -18 \\ \hline (4, -18) \end{array}$$

**Exercise #1:** Consider the quadratic function  $f(x) = x^2 - 4x - 5$ . The quadratic functions  $g$  and  $h$  are defined by the formulas  $g(x) = 2f(x)$  and  $h(x) = \frac{1}{2}f(x)$ .

- (a) Determine formulas for both  $g$  and  $h$  in simplest trinomial form.

$$\begin{aligned} g(x) &= 2f(x) \\ &= 2(x^2 - 4x - 5) \\ &= 2x^2 - 8x - 10 \end{aligned} \qquad \begin{aligned} h(x) &= \frac{1}{2}f(x) \\ &= \frac{1}{2}(x^2 - 4x - 5) \\ &= \frac{1}{2}x^2 - 2x - \frac{5}{2} \end{aligned}$$

- (b) Using your calculator, sketch and label each curve on the set of axes below. Use the window indicated by the axes.



- (c) Using the **MINIMUM** command on your calculator, determine the minimum value for each function.

$$f_{\min} = -9$$

$$g_{\min} = -18$$

$$h_{\min} = -4.5$$

- (d) What points did not vary when  $f$  was vertically dilated by factors of 2 and  $1/2$ ? Explain why this happened.

The zeros (x-intercepts) do not change. Multiplying 0 by any number will still be 0.

### VERTICAL DILATIONS OF FUNCTIONS

The function  $h(x) = k \cdot f(x)$  represents a vertical stretch of the function  $f(x)$  if  $k > 1$  and a vertical compression of the function  $f(x)$  if  $0 < k < 1$ .

**Exercise #2:** If the point  $(-3, 12)$  lies on the graph of the function  $y = f(x)$ , which of the following points *must* lie on the graph of  $y = 3f(x)$ ?

(1)  $(-9, 36)$

(3)  $(-3, 4)$

(2)  $(-3, 36)$

(4)  $(-9, 12)$

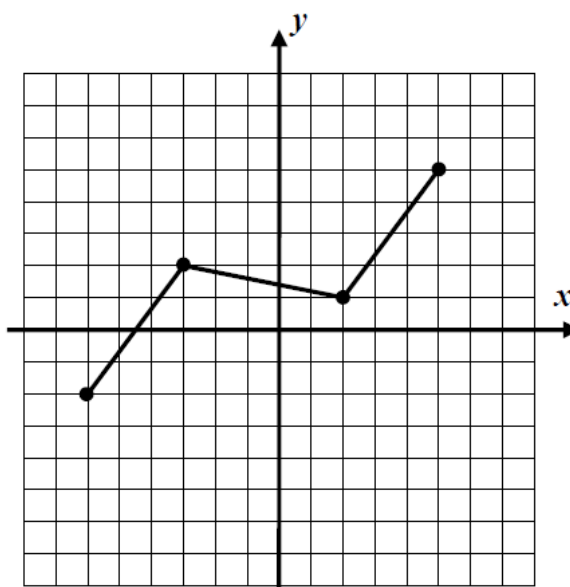
**Exercise #3:** The graph of  $y = f(x)$  is shown below. Consider the function  $y = g(x)$  defined by  $g(x) = 2f(x) - 3$ .

\* Follow PEMDAS "

- (a) What two transformations have occurred to the graph of  $f$  in order to produce the graph of  $g$ ? Specify both the transformations and their order.

- ① Vertical stretch by 2  
② Down 3 units

- (b) Graph and label  $y = g(x)$



**Exercise #4:** The function  $h(x)$  has a range given by the interval  $[2, 10]$ . The function  $f(x)$  is defined by  $f(x) = \frac{3}{2}h(x) + 8$ . Which of the following gives the range of  $f(x)$ ?

- |                |                |
|----------------|----------------|
| (1) $[11, 23]$ | (3) $[15, 27]$ |
| (2) $[8, 12]$  | (4) $[6, 32]$  |

**Exercise #5:** If the quadratic function  $g(x)$  has a  $y$ -intercept of 12, which of the following is true about the function  $h(x) = 3g(x) - 5$ ?

- (1) It has a  $y$ -intercept of -5.
- (2) It has a  $y$ -intercept of 21.
- (3) It has a  $y$ -intercept of -15.
- (4) It has a  $y$ -intercept of 31.